REPORT
ON
DEVELOPMENT OF THE SAN FRANCISCO BAY REGION

PREPARED FOR

THE FACT-FINDING COMMITTEE OF THE CALIFORNIA ASSEMBLY
ON
TIDELANDS RECLAMATION AND DEVELOPMENT,
RELATED TRAFFIC PROBLEMS
AND RELIEF OF CONGESTION ON TRANSBAY CROSSINGS

BY

JOHN L. SAVAGE, CONSULTING ENGINEER
DENVER, COLORADO

AND

INTERNATIONAL ENGINEERING COMPANY, INC.
SAN FRANCISCO, CALIFORNIA

JANUARY, 1951

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OUTLINE OF REPORT

PART I

SUMMARY

PART II

INTRODUCTION

PART III

THE PROBLEM

[illegible] the Bay Region [illegible]

[illegible] be needed to be eight, and plans must be [illegible]

[illegible] shortages. The State Division of Water Resources has [illegible]

[illegible] Water Plan" for all California. This publication [illegible]

[illegible] be necessary in this report to discuss only [illegible]

3.2 LAND USE - PRESENT AND FUTURE

The manner in which land is used at present or [illegible] urban [illegible] development, individual private enterprises have no restriction on the [illegible] for agricultural, industrial, shipping and residential purposes. [illegible] has developed to such a stage that an overall pattern should now be [illegible] by adoption.

The following information is available:

1. Maps of the Soil Conservation Service, which indicate the land [illegible] potentialities, limitations, and needs.
2. A comprehensive report by Robert P. Daniel son, published by the [illegible] Area Council, entitled "Industrial Locations in the San [illegible] Area". This contains a forecast as to future industrial [illegible]
3. A similar report, issued in 1945 by the [illegible] entitled "The Area Real Estate Report". This has proved useful in [illegible] residential areas.

Zonin[illegible] indicates present land use. Crop [illegible] by [illegible] are also employed as follows:

Nature of Crop	[illegible]
Orchards and vineyards	[illegible]
Row crops	[illegible]
Small grain	[illegible]
Hay and pasture	[illegible]
Fallow	[illegible]

Using data obtained from the Soil Conservation Service, it is estimated that in the Bay Area region there is a total of 309,240 acres suitable for irrigation if water is available, located as follows:

County	Acres
Alameda	58,230
Contra Costa	40,770
Marin	12,770
Napa	36,520
Santa Clara	103,930
Solano	23,800
Sonoma	33,220
Total	309,240

Assuming that the present crop pattern prevails in the future, this irrigable land will be used as follows:

Nature of Crop	Acreage
Orchards and vineyards	119,130
Row crops	47,630
Small grain	102,410
Hay and pasture	40,070
Total	309,240

From various records available, it is estimated that irrigated land at present gets about 2.52 acre-feet of water per acre per year. This is probably a high figure inasmuch as the State water plan allows slightly less than 2.0 in both the Sacramento and San Joaquin valleys. Therefore, for future irrigation, we have estimated 2.0 acre-feet per acre per year, and the future requirement will thus be about 620,000 acre-feet annually.

Table II gives an idea of probable future land use in the Bay Region as of the year 2000.

Plate III shows the geographical location of areas of various uses. These locations and figures above given form a partial basis on which to estimate future requirements for water and transportation facilities.

[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]

GENERAL

DESCRIPTION OF REBER PLAN AS PROPOSED BY JOHN REBER

The Reber Plan merits special consideration because it is the only approach to a master plan for future development of the Bay Region which has ever been offered. As proposed by Mr. John Reber, it involves development of the following various features (as shown on Plate VI, which is reproduced as published in Western Construction issue of March, 1943):

a. An earth and rock dam across the Bay connecting Marin and Contra Costa counties.

b. A second earth and rock dam across the Bay connecting San Mateo and Alameda counties.

c. Creation of additional lands by filling in the shallow eastern part of San Francisco bay over a 3-mile width for a length of 11 miles.

d. A combined ship channel and canal connecting the two bodies of water which would lie respectively south of the Marin-Contra Costa barrier and south of the San Francisco-Alameda barrier.

e. Ship locks to provide access from the open Bay to the two bodies of water.

f. Highway and rail crossings of the Bay on the two dams (hereinafter called the North Barrier and the South Barrier).

g. Submarine homes, air fields, marine terminals, etc.

The outstanding feature distinguishing the plan is that water from the Sacramento Rivers would be conveyed thru aqueducts to the bodies of water lying south of the barriers.

SAN JOAQUIN &

The Report Plan requires the construction of [illegible] is unsuitable. In a preliminary study of this nature, it is not possible [illegible] to be made [illegible] to be made [illegible] knowledge of structures of this nature. A complete investigation might [illegible] structures substantially different from those selected for this [illegible] would be more suitable.

11.2 Geology

11.21 General

San Francisco Bay lies in the trough formed by the uplift of the Coastal and other mountains on the west and the uplift of the Sierra Nevada on the east. The ancient Sacramento River maintained its general course during the uplift and cut through the ranges at both the Golden Gate and Carquinez Straits, flooding the trough. The sediments which have been deposited on the floor of this drowned "valley" are extremely complex and consist of clays, sands and silts, and Pleistocene delta deposits of sand, silt, and clay. The cycle of deposition and subsequent erosion of these sediments have been complex. Hence while some generalizations may be made about [illegible] the [illegible] are very [illegible].

11.22 Earthquake

There are no known active faults within the area of the [illegible] by the earthquake. The structures might be subjected to seismic forces of [illegible] as those to be expected in the general area, such as in the Santa [illegible] of San Francisco and Oakland. It is believed that [illegible]

[illegible]

[illegible] DISCHARGES OF SAN JACINTO RIVER AT [illegible]

Period	Annual Discharge (000 cfs)	Annual Discharge Divided by Drainage Area (cfs/sq mi)
Feb 14 - Mar 7	[illegible]	[illegible]
Mar 2 - Apr 10	[illegible]	[illegible]
Jan 15 - Jun 25	[illegible]	[illegible]
Mar 20 - Apr 10	[illegible]	[illegible]
Feb 1 - Feb 9	[illegible]	[illegible]
Mar 17 - Mar 31	[illegible]	[illegible]
Jan 6 - Jan 31	[illegible]	[illegible]
Feb 1 - Feb 18	[illegible]	[illegible]
Dec 7 - Dec 17	[illegible]	[illegible]
Jan 28 - Feb 6	[illegible]	[illegible]
Mar 5 - Mar 13	[illegible]	[illegible]
Dec 21 - Jan 14	[illegible]	[illegible]
Jan 13 - Feb 5	[illegible]	[illegible]
Feb 5 - Mar 5	[illegible]	[illegible]
Jan 28 - Feb 9	[illegible]	[illegible]
May 8 - May 21	[illegible]	[illegible]
Jan 21 - Jan 27	[illegible]	[illegible]
Feb 5 - Feb 12	[illegible]	[illegible]
Feb 23 - Mar 3	[illegible]	[illegible]
Feb 7 - Feb 16	[illegible]	[illegible]
Nov 16 - Nov 25	[illegible]	[illegible]
Jan 17 - Feb 4	[illegible]	[illegible]
Feb 3 - Feb 17	[illegible]	[illegible]
Feb 2 - Feb 12	[illegible]	[illegible]
Feb 16 - Mar 3	[illegible]	[illegible]
Mar 23 - Apr 2	[illegible]	[illegible]
Dec 11 - Dec 31	[illegible]	[illegible]
Apr 7 - Apr 15	[illegible]	[illegible]
Jan 13 - Jan 19	[illegible]	[illegible]
Feb 21 - Feb 29	[illegible]	[illegible]
Dec 10 - Dec 16	[illegible]	[illegible]
Feb 1 - Mar 1	[illegible]	[illegible]
Mar 1 - Mar 31	[illegible]	[illegible]
Feb 26 - Mar 6	[illegible]	[illegible]
Mar 26 - Apr 5	[illegible]	[illegible]
Dec 17 - Jan 14	[illegible]	[illegible]
Jan 12 - Feb 1	[illegible]	[illegible]
Feb 4 - Feb 20	[illegible]	[illegible]
Feb 20 - Mar 10	[illegible]	[illegible]
Jan 21 - Feb 19	[illegible]	[illegible]
Jan 25	[illegible]	[illegible]
Mar 12	[illegible]	[illegible]
Feb 5	[illegible]	[illegible]
Dec 31	[illegible]	[illegible]
Nov 29	[illegible]	[illegible]

[illegible] 1,000 acres of filled lands [illegible] would be [illegible] by fill from ship channel excavation [illegible] be assessed with these values. Further deducting these [illegible], the result is $9,000,000. Deducting this [illegible] [illegible] as the net first cost of the Reber Plan [illegible] proper.

13.22 Of [illegible] Water Supply to [illegible]

It would be necessary either to buy and use [illegible]

[illegible]

[illegible]

37 miles – 50" pipe @ $[illegible],000/mile	$[illegible]
30 miles – earth canal @ $150,000/mile	[illegible]
20 miles – 40" pipe @ $250,000/mile	[illegible]
36 miles – 12" pipe @ $64,000/mile	[illegible]
40 miles distribution canals @ $[illegible]/mile	[illegible]
	$ [illegible]
Pumping installations – 7500 hp @ $100/hp	750,000
Miscellaneous, say 20% ±	[illegible]
	$ [illegible]

13.23 Of Sewage Treatment Works

Primary sewage treatment is required regardless whether or not the Reber Plan is carried out. Secondary sewage treatment would be necessary if effluents were to be discharged into a fresh water lake, which would of course have to be kept in an unobjectionable condition. At present the vast amounts of tidal water flowing in and out dilute sewage, but the construction of the Reber Plan would make these amounts of water no longer available in the north and south lakes. The costs of secondary treatment works are, therefore, a part of the costs of the Reber Plan.

Plate X shows the construction cost of sewage treatment works ([illegible] percent efficiency treatment) based upon an article by C. J. V[illegible]

As development of the Central Valley and the [illegible] proceeded, the water required to make the Reber Plan [illegible] would become valuable, and would finally be worth some $[illegible] an acre-foot, the basis for extra treatment of sewage, and the value of the land so supplied would increase. The annual costs would thus ultimately reach a total of some $71,500,000 more than the previously-given figure of $[illegible], a total of $69,759,500.

13.4 ANNUAL BENEFITS

13.41 General

In reckoning up the annual benefits to the community contingent upon the realization of the Reber Plan, consideration must be given only to the annual production of new wealth, or to actual savings of costs. The value of new agricultural production, or the savings effected because of cheaper water supplies, are cases in point. On the other hand, tolls collected on bay crossings are not benefits; the money is not created by the crossings but is already in existence, and toll-taking merely transfers it from one pocket to another. Tolls are actually a special form of taxation, under which the specially benefited parties pay.

13.42 Benefits Because of Irrigation

At present 102,680 acres of agricultural land in the [illegible] area are irrigated. There is a total of 309,240 acres which can be irrigated, which means there are yet 206,560 acres which could be brought under irrigation assuming a suitable water supply available. With the fresh water [illegible] this acreage would unquestionably be brought into fullest production. It is necessary to compute the value of possible production from this acreage, and also the value of present production, and production costs. By [illegible]

Benefits Accruing in the Delta Region

Assuming proper handling of the spillway [illegible] flow, tidal effects in the Delta would be practically eliminated. In 1931 damage to the value of about $200,000 was caused by tidal action alone. This does not occur every year, and the average annual amount saved is arbitrarily estimated at $150,000.

The realization of the Bacon Plan would result in the complete disappearance of any salinity problem in the Delta Region. Benefits accruing by reason of such realization would be measured by the difference between no salinity at all and the worst condition occurring since Shasta Dam has been operated.

In 1931 salinity did creep up the rivers to the extent that some 15,000 acres on Sherman, Twitchell, Bradford and Jersey Islands were surrounded by channels containing chlorides in excess of 100 parts per 1,000,000 parts of water. This is the area which would be benefited by a salt and water barrier.

The Bureau of Reclamation, in 1947, published a study, entitled "Central Valley Project Studies, Payments by Beneficiaries, Problem No. 13". In this report the crops raised on the delta were listed as alfalfa, asparagus, beans, beets, celery, corn, fruit, grain and hay, onions, pasture, potatoes, seed, and truck. The value per acre in dollars was given for each of the above crops from 1932 through 1942. Also from this report it is possible to compute the percentage of crop value lost when surrounding channels are filled with salt water.

Utilizing prices received by farmers as given by the Federal Crop and Livestock Reporting Service, it is possible to compute the value per acre of the several crops in 1940. The number of acres of each crop [illegible] multiplied by its value. The total value of the crops of course is then [illegible]

[illegible] Table No. [illegible] the total annual benefit [illegible] estimated at $[illegible].

The total benefits in the Delta Region would [illegible] $[illegible],000 per year.

13.46 Benefits Accruing from Prevention of Intrusion of Salt Water

Saline intrusion into ground water supplies in [illegible] and southwestern Alameda Counties would be stopped by the substitution of [illegible] for salt water in the south lakes. Some authorities have estimated that 60,000 acres in Alameda County are endangered by such intrusions. It is assumed that 25,000 acres of this area are actually cultivated, under the following present and with the following annual values of production:

Acres	Crop	Value/Acre	Total Value
15,000	Pasture	$ 70.00	$ 1,050,000
3,000	Alfalfa	65.00	200,000
7,000	Row crops	150.00	1,050,000

Past experience in the Delta Region, crop loss due to saline irrigation water most of the time is estimated at 10% for pasture and alfalfa and 7% for row crops. This should be taken as a minimum. If salinity forced complete abandonment of the lands, the entire annual production would be lost. The maximum loss in Alameda County is thus $370,500 annually and the maximum $2,700,000

The benefits in Santa Clara County are assumed to be [illegible] thirds as great, and therefore would be from $247,000 to $1,800,000 annually.

13.46 Benefits Accruing from Elimination of Marine Borers

Marine borers cannot live in fresh water. It is estimated that if piling were not creosote-treated, about 4,000,000 lineal feet would have to be replaced annually because of marine borer attack. The cost of [illegible]

Crop	No. of Acres	Value per Acre 1982 Crop	Yield per Acre	Price per Unit	Value per Acre 1910 Crop	Crop Loss by Salinity	Total Annual Loss (Existing Conditions)
Alfalfa	240	$ 69.00	5 tons	$ 13.80	$ 19.20	15%	$ 600
Asparagus	2,500	1,487.00	3,000 lbs.	49.57	210.00	10%	10,500
Beans	280	77.20	1,400 lbs.	0.14	79.10	5%	1,000
Beets	1,720	97.60	1,400 lbs.	10.70	196.10	8%	16,300
Celery (Late Fall)	250	540.00	1,200	1.00	216.00	10%	5,400
Corn, S	2,140	44.20	1,200	1.60	92.10	4%	3,800
Chard (Swiss)	350	535.00	29,000	18.20	501.00	6%	16,000
Lettuce and Hay (Data) *	2,680	21.30	1,400	30	32.20	0%	0
Melons (Late Summer)	0	160.00	1,000	1.50	516.00	0%	0
Peppers (U. Bell)	1,120	5.00	2,000	5.00	2.00	0%	0
Potatoes (Early)	0	0.00	1,100	1.35	0.00	0%	0
Wheat (Winter)	0	0.00	0	3.50	0.00	0%	0
Total	7,700	0.00	0	0.00	0.00	0%	0
	7,700						$ 53,600

[illegible] costs [illegible] by the construction of [illegible]
[illegible]. These [illegible] cost is about $0.50 per linear foot, [illegible]
[illegible] $75,000.

13.67 Benefits of Spiraling

In salt water, barnacles [illegible] [illegible]
[illegible] ship speed and increasing necessary propelling power. [illegible]
[illegible] docked periodically, and barnacles removed. Or, if a vessel [illegible]
from water for a while, the barnacles die and drop off.

It is estimated that in 1949, 300 dry dockings [illegible]
were for barnacle removal at an average cost of $1,700 each, and that if the
Rebar Plan had been realized, 100 of these could have been avoided, a
[illegible] saving of $170,000. Assuming twice the 1949 traffic in the future, the
annual saving would be $340,000.

13.68 Benefits Accruing from Highway Crossings

As has been stated elsewhere, tolls collected on highway
crossings cannot be considered as benefits, but only as a special form of tax
[illegible] imposed on users. It becomes necessary to devise some measure of [illegible]

If the Rebar Plan is not realized, crossings of [illegible]
safety will be otherwise provided and thereby certain annual costs will be
incurred. Since these costs would be avoided by realization of the Rebar [illegible]
it seems fair to credit the Rebar Plan with such costs as benefits.

The Southern Crossing was estimated by the Division of Bay
Toll Crossings in 1948 to cost $178,421,000 for six lanes. Present day [illegible]
would be about $200,000,000. Provision of a fourth tube and connecting [illegible]
to provide eight lanes as in the Rebar Plan would bring the capital cost [illegible]
to [illegible] $240,000,000. The Berkeley-Oakland Contra County Bridge has been estimated

[illegible] at $[illegible] per [illegible] $[illegible]

[illegible] [illegible]

Total $[illegible]

[illegible] costs are estimated as follows:

Interest 3.0% of $[illegible]	$1,500,000
Amortization 1.32% of $117,000,000	1,550,000
Depreciation 2.5% on about $[illegible]	[illegible]
Operation and maintenance	[illegible]
Total	$ [illegible]

16.22 The Power and Pumping Plant

Plant costs are estimated as follows:

[illegible]	$ [illegible]
Pumping Plant	[illegible]
	$ [illegible]

[illegible] costs are estimated to be $[illegible].

16.23 The Salt Barrier

Plant costs are estimated to be $333,600,000, and annual costs to be $6,509,000.

16.24 Other Costs

If a supply of salt water were developed for [illegible] of the south barrier, the plant cost would be $[illegible]. Water [illegible] would require extra treatment, and the necessary facilities would cost perhaps $13,000,000.

Annual costs are estimated to be:

For salt water supply	$ [illegible]
For sewage treatment	[illegible]
Total	$ [illegible]

[illegible] being achieved various political organizations [illegible]. It should be definite enough so that it could be [illegible] and orderly efficiency (without, for example, such delay as [illegible] in coming to a decision on a second Bay crossing). It must be sufficiently flexible so that it can be adjusted to future requirements which we cannot now foresee. New inventions, new customs and new needs [illegible] the commercial and social life of the Bay Region. It is only necessary to point out that if a master plan had been prepared in 1910, it would have concerned [illegible] provisions for automobile traffic.

It is more proper to say that we consider that the San Francisco Bay Region owes a debt of gratitude to Mr. John Reber, and to the sincere and earnest proponents of the plan which bears his name. We believe that they have brought home to many minds the idea that there must be a master plan, and that in so doing they have performed a great public service.

The trans-bay traffic problem alone renders prompt action imperative.

The master plan must benefit the community as a whole, but it cannot [illegible] unavoidably, unavoidably, some individual interests will be damaged, while others will be enhanced. Thus, many features of the plan will be controversial.

It appears to us that some sort of a legal entity or organization must be formed, to develop a master plan, keep it up to date, and to control future development in accordance with the plan, and we recommend the creation of such an organization. It might very well take the form of a [illegible] salaried board composed of prominent citizens with records of [illegible] accomplishment, which board would act through a salaried general manager and necessary staff. The board would deal with Federal, State and [illegible] in all matters touching on development. It should be clothed

[illegible] authority. It should be provided [illegible] carrying out a comprehensive investigation of [illegible] of the San Francisco Bay Region. Thereafter, [illegible] to advise on suitable appropriations and actions.

[illegible]SSION AND SIGNATURES

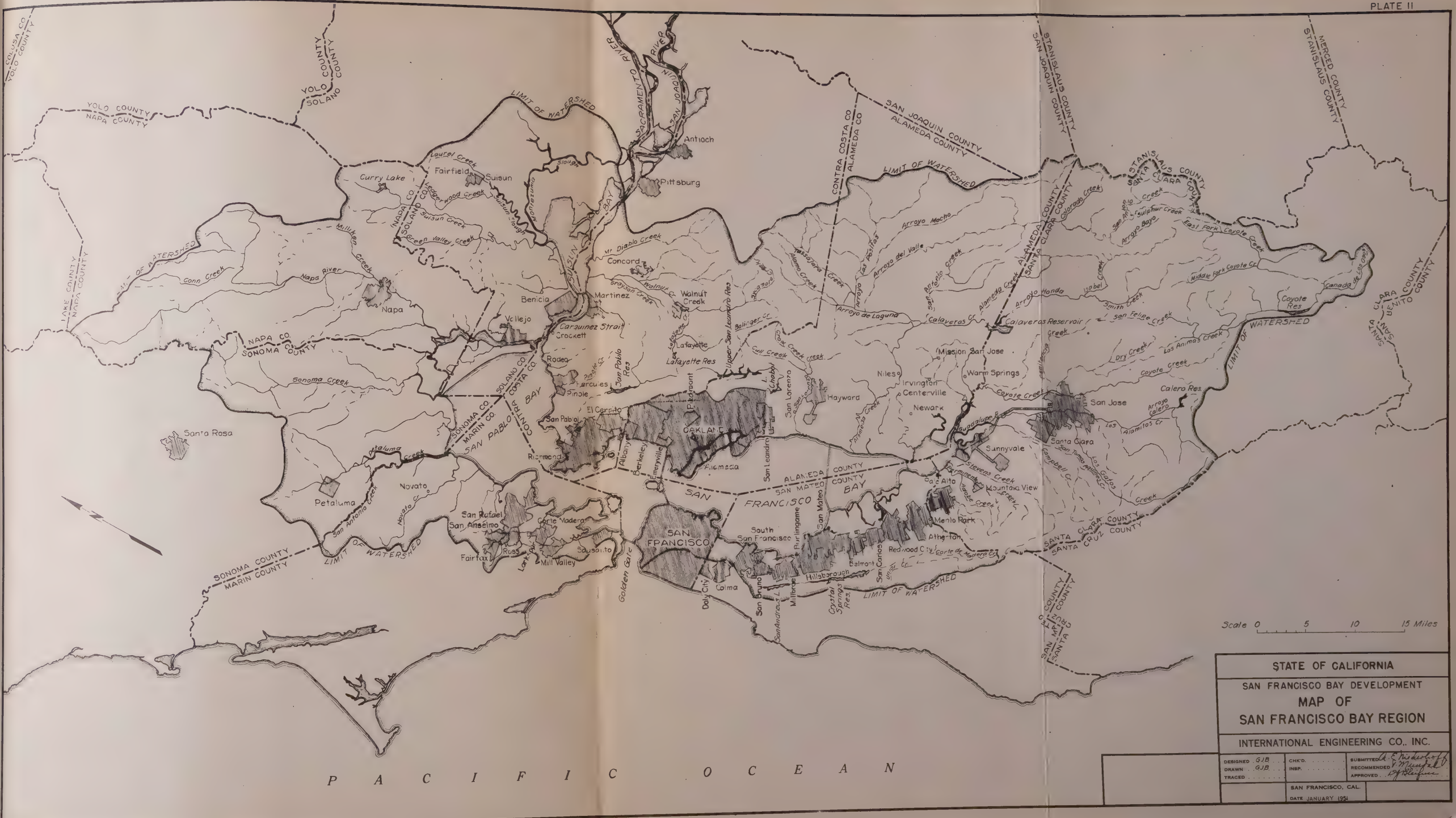
This report is hereby respectfully submitted to the Interim Committee of the California Assembly on Tidelands Reclamation and [illegible] Related Traffic Problems, and Relief of Congestion on Transbay Crossings.

1. [signature]
John L. Savage
Consulting Engineer

2. For: INTERNATIONAL ENGINEERING COMPANY, INC.

[signature]
Vice President & Chief Engineer

Approved: [signature]
C. F. Ulrich
President



STATE OF CALIFORNIA

SAN FRANCISCO BAY DEVELOPMENT

MAP OF SAN FRANCISCO BAY REGION

INTERNATIONAL ENGINEERING CO., INC.

DESIGNED GJB	CHK'D.	SUBMITTED L. E. Friedkoff
DRAWN GJB	INSP.	RECOMMENDED V. Mundal
TRACED		APPROVED D. P. Haffen

SAN FRANCISCO, CAL.

DATE JANUARY 1951

PLATE III

LEGEND

- Industrial and commercial
- Public and institutional
- Residential:
- Agricultural:
- Grazing
- Unclassified

Scale 0 5 10 15 Miles

STATE OF CALIFORNIA

SAN FRANCISCO BAY DEVELOPMENT

FUTURE LAND USE

INTERNATIONAL ENGINEERING CO., INC.

DESIGNED GJB	CHK'D.	SUBMITTED
DRAWN GJB	INSP.	RECOMMENDED
TRACED		APPROVED

SAN FRANCISCO, CAL.

DATE JANUARY 1951

PLATE IV

MILLIONS

HUNDRED THOUSANDS

5
4
3
2
1
9
8
7
6
5
4
3
2
1

Historical population
9 Bay counties

(5) (6) (8)
(3) & (4) (2)
(1) (7)
Forecast

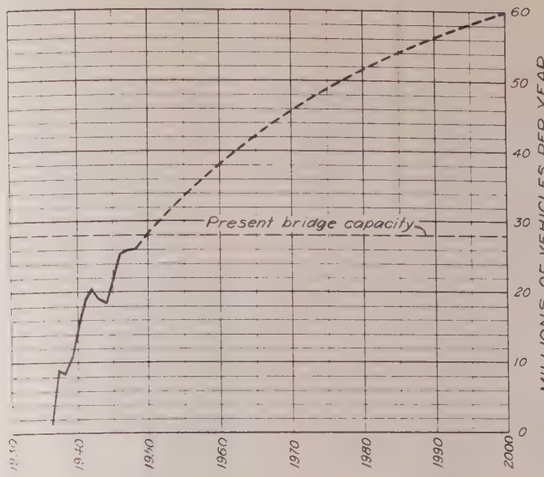
1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000

Estimates made by:
① East Bay Municipal Utility District
② Calif. Reconstr. & Reemployment Comm.
③ J. Riley, Calif. Aeronautics Comm.
④ Calif. Div. of Highways
⑤ W.A. Spurr, Stanford Univ.
⑥ San Mateo Planning Comm.
⑦ Bay Area Airport Planning Gr.
⑧ San Francisco Dept. of City Planning

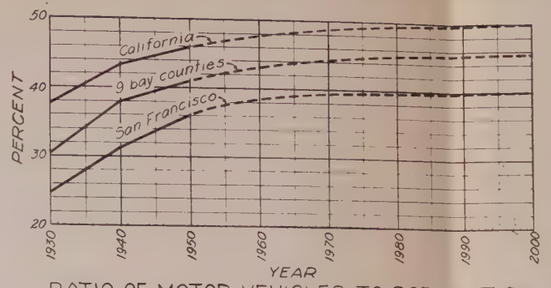
STATE OF CALIFORNIA
SAN FRANCISCO BAY DEVELOPMENT
POPULATION GROWTH

INTERNATIONAL ENGINEERING CO., INC.
SAN FRANCISCO, CALIF.

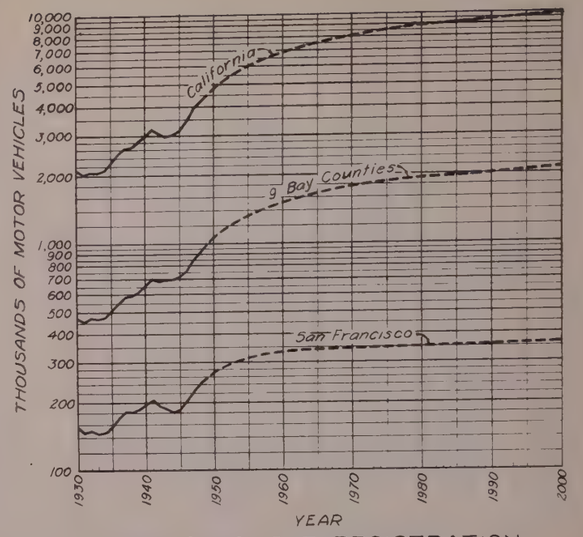
DR. R.P.M.	RECOMMENDED	APPROVED
CK.	A.E. Mudenhoff	O.F. Bleifuss
DATE: JANUARY 1951		



SAN FRANCISCO-OAKLAND BAY BRIDGE
VEHICULAR TRAFFIC

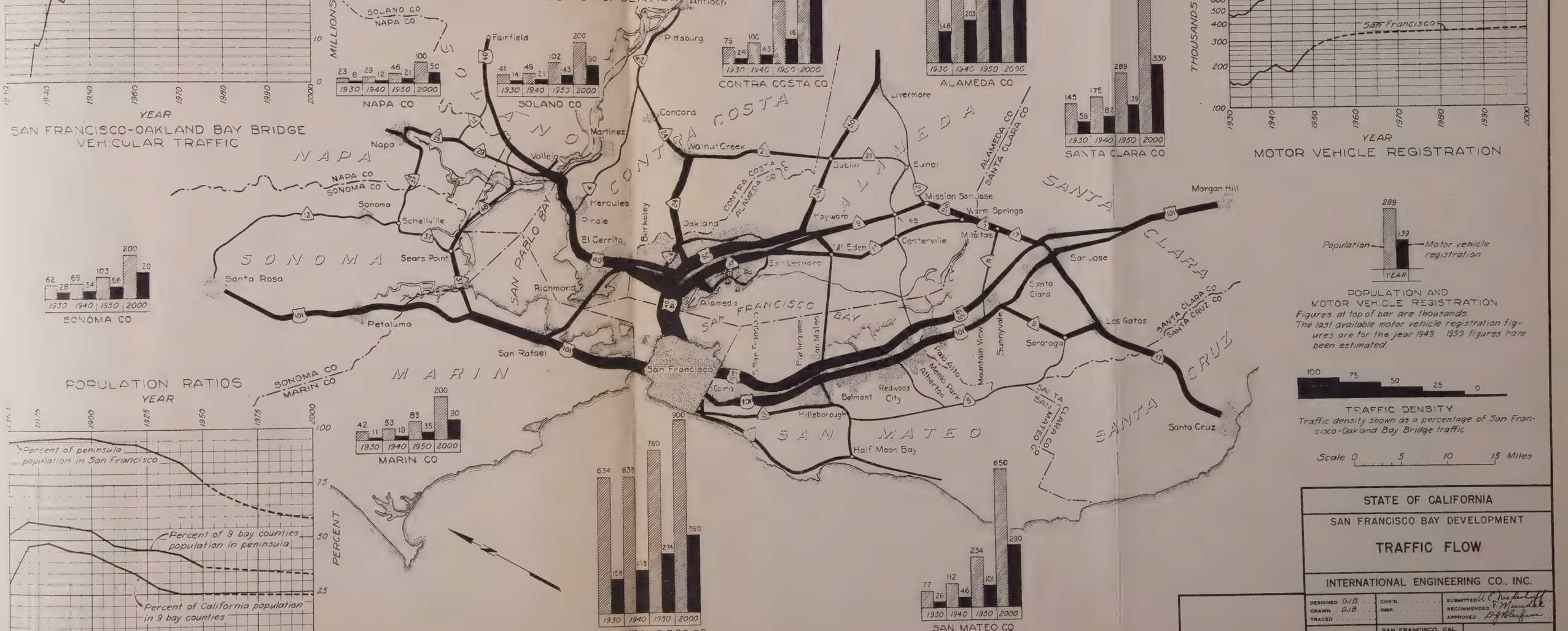


RATIO OF MOTOR VEHICLES TO POPULATION



MOTOR VEHICLE REGISTRATION

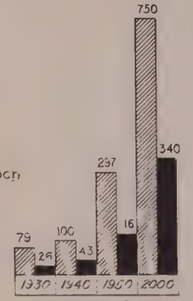
POPULATION RATIOS



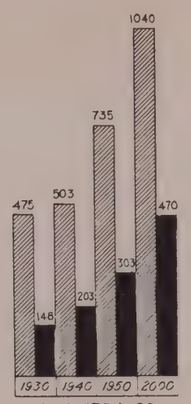
SONOMA CO

NAPA CO

SOLANO CO



CONTRA COSTA CO



ALAMEDA CO

SANTA CLARA CO

MARIN CO

SAN FRANCISCO CO

SAN MATEO CO

POPULATION AND
MOTOR VEHICLE REGISTRATION

Figures at top of bar are thousands. The last available motor vehicle registration figures are for the year 1949. 1950 figures have been estimated.

TRAFFIC DENSITY

Traffic density shown as a percentage of San Francisco-Oakland Bay Bridge traffic

Scale 0 5 10 15 Miles

STATE OF CALIFORNIA

SAN FRANCISCO BAY DEVELOPMENT

TRAFFIC FLOW

INTERNATIONAL ENGINEERING CO., INC.

DESIGNED GJB. . . CHK'D. . . . . SUBMITTED
DRAWN GJB. . . INSP. . . . . RECOMMENDED
TRACED . . . . . APPROVED

SAN FRANCISCO, CAL.

DATE JANUARY 1951

PLATE VII

RICHMOND
ALBANY
BERKELEY
OAKLAND
ALAMEDA
BAY FARM ISLAND
Eastshore Freeway
Posey Tube
2 - Two Lane Highway Tubes under Estuary
Alameda Approach
Naval Reservation
Existing Bay Bridge
Cutting Blvd.
Garrard Blvd
New 2 Lane Tunnel
Point Richmond
Standard Oil (Chevron) Pier
Turning Basin 50' Navigable Depth
Ship Channel - 40' Navigable Depth
Ship Channel - 50' Navigable Depth
2 - Two Lane Highway Tubes
DIKE
One Lock 140' x 1200' x 45'
Two Locks 80' x 760' x 32'
Two Locks 50' x 400' x 17'
Lock Approach Channel 50' Depth MLLW
Existing Cantilever Span
1330' Horizontal Clearance
189' Vertical Clearance
4 - Two Lane Highway Tubes
TREASURE ISLAND
YERBA BUENA ISLAND
Access Road 40.0'
Clean sand hydraulic fill
Dumped Rock
TYPICAL CROSS SECTION DIKES
Scale 0 50 Feet
NORTH DAM
SOUTH DAM
Salt Water Sluices
110.0'
2-12' Highway Lanes
℄ Sym
Clean sand Hydraulic fill
TYPICAL CROSS SECTION NORTH DAM
Scale 0 100 Feet
Space for Future Highway Lanes or Railroad Track
275.0'
4-12' Highway Lanes
Excavate soft bay - mud in this area
TYPICAL CROSS SECTION SOUTH DAM
Scale 0 100 Feet
Rock to be ungraded, except very heavy rock in closure section and rock selected for durability at water surface.
Bluff Point
Spillway
TIBURON
Raccoon Strait
Approach Road to Highway 101
ANGEL ISLAND
ALCATRAZ ISLAND
SAN FRANCISCO BAY
EMBARCADERO
San Francisco Approach
Bayshore Freeway
SAN FRANCISCO
HUNTERS POINT
FINAL ELEVATION TOP OF ALL DAMS AND DIKES +12 USGS (MEAN SEA LEVEL) DATUM.
Scale 0 5000 Feet

STATE OF CALIFORNIA

SAN FRANCISCO BAY DEVELOPMENT

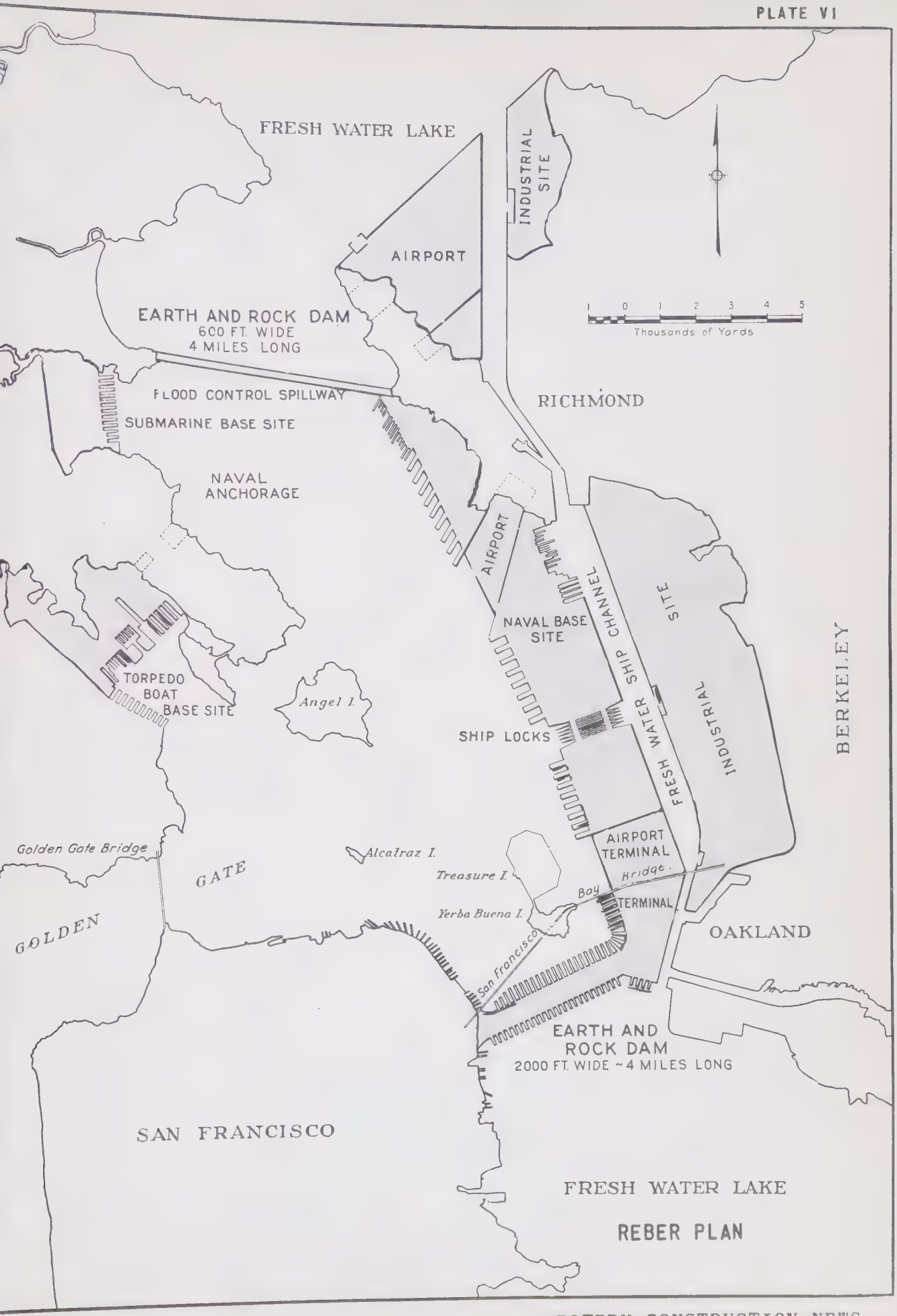
MODIFICATIONS OF THE REBER PLAN PROPOSED BY INTERNATIONAL ENGINEERING CO., INC.

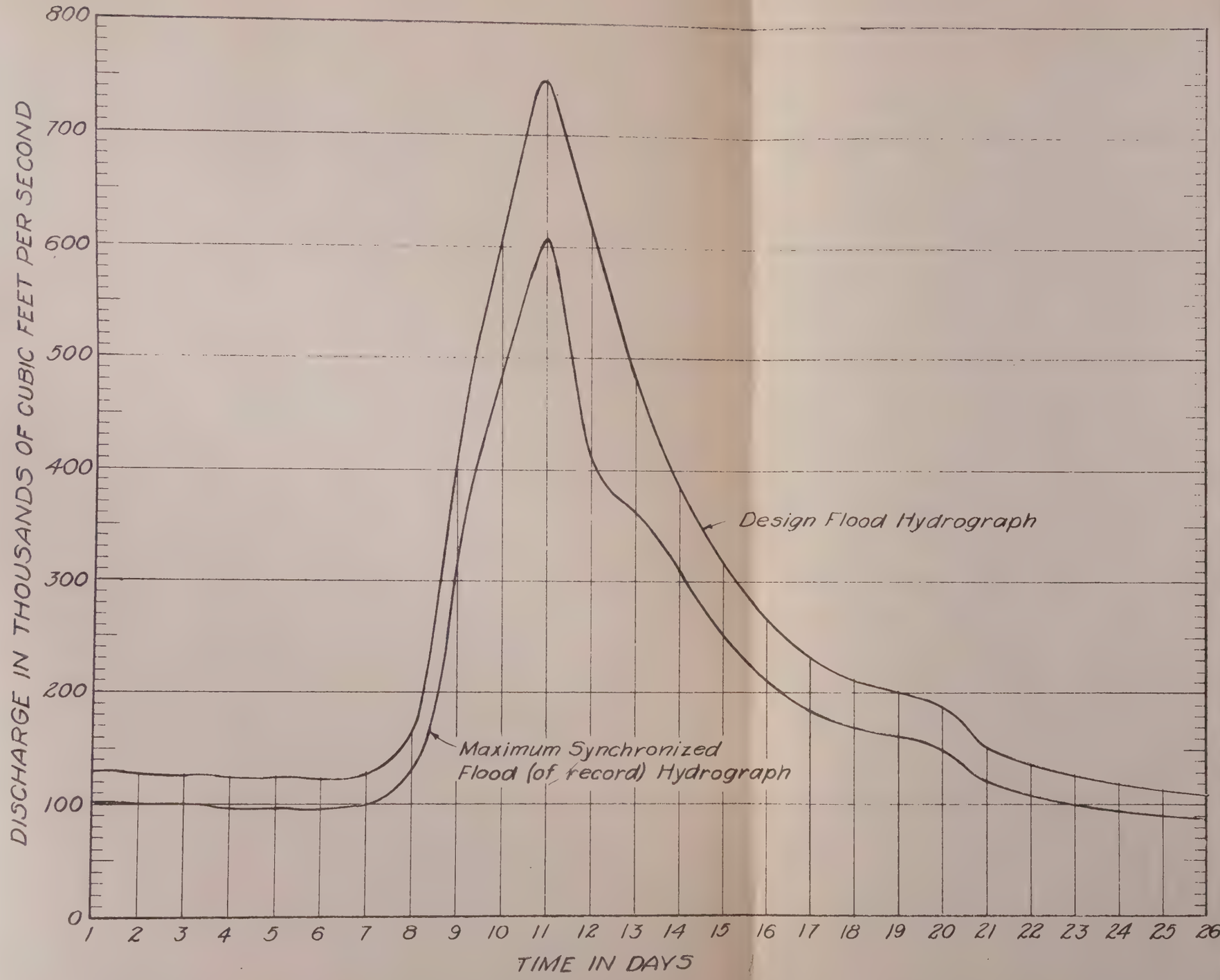
INTERNATIONAL ENGINEERING CO., INC.

DESIGNED G.F.S. - J.P.H.	CHK'D	SUBMITTED H. Dudman
DRAWN R.P.M.	INSP.	RECOMMENDED F. Mundel
TRACED		APPROVED D.P. Harrison

SAN FRANCISCO, CAL.

DATE JANUARY, 1951


FRESH WATER LAKE
INDUSTRIAL SITE
AIRPORT
EARTH AND ROCK DAM
600 FT. WIDE
4 MILES LONG
1 0 1 2 3 4 5
Thousands of Yards
FLOOD CONTROL SPILLWAY
RICHMOND
SUBMARINE BASE SITE
NAVAL ANCHORAGE
AIRPORT
NAVAL BASE SITE
FRESH WATER SHIP CHANNEL
INDUSTRIAL SITE
BERKELEY
TORPEDO BOAT BASE SITE
Angel I.
SHIP LOCKS
AIRPORT TERMINAL
Golden Gate Bridge
Alcatraz I.
GATE
Treasure I.
Bay Bridge
TERMINAL
Yerba Buena I.
GOLDEN
San Francisco
OAKLAND
EARTH AND ROCK DAM
2000 FT. WIDE ~ 4 MILES LONG
SAN FRANCISCO
FRESH WATER LAKE
REBER PLAN

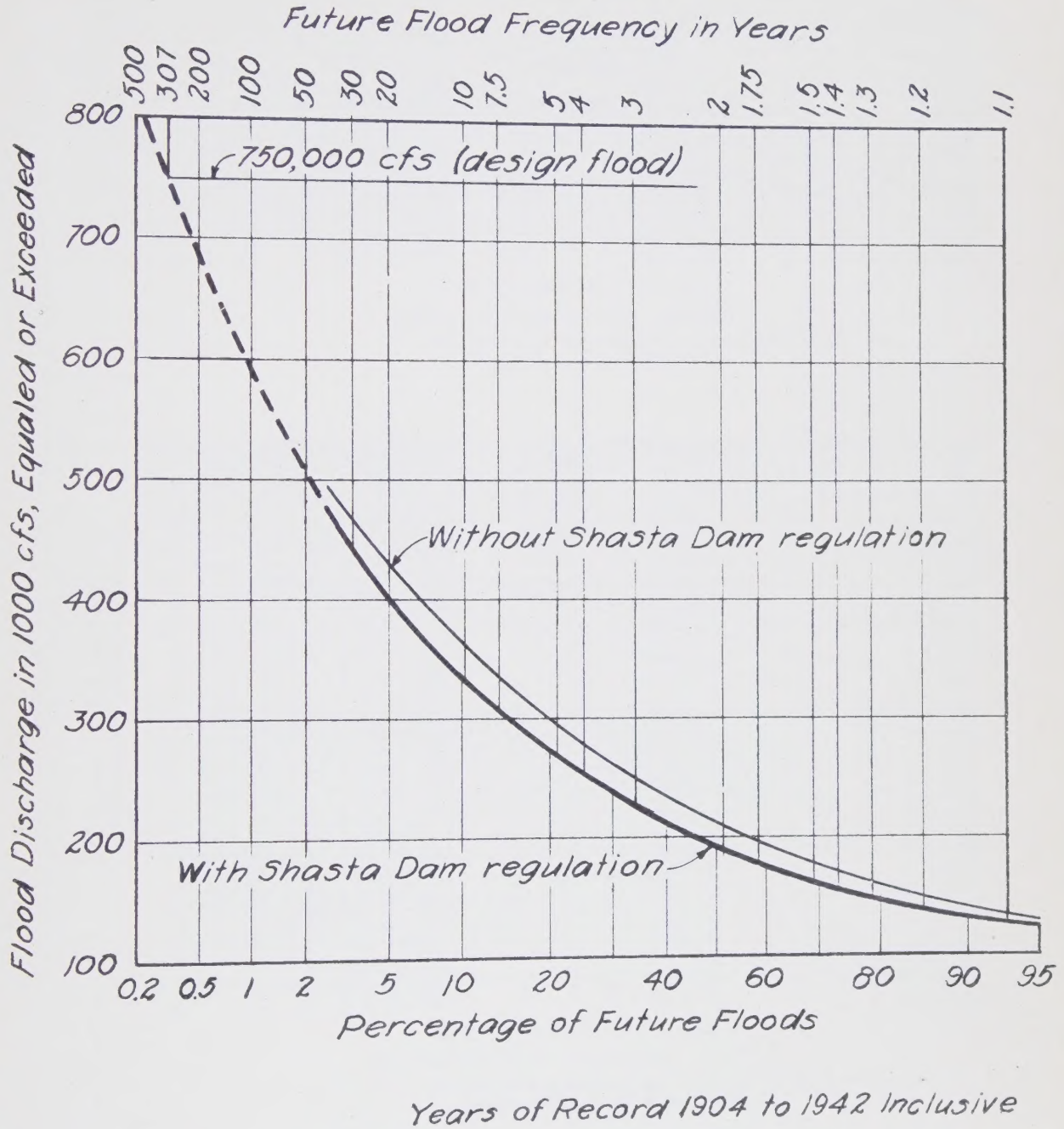


NOTE

Maximum synchronized flood was determined by combining the maximum daily average discharges from

- Mokelumne River at Clements (Mar. 16 to Apr 10, 1928)
- San Joaquin River near Vernalis (Mar. 6 to Mar. 31, 1940)
- Cosumnes River at McConnell (Feb 28 to Mar 25, 1940)
- Dry Creek near Galt (Jan 23 to Feb 17, 1945)
- Calaveras River at Jenny Lind (Mar. 15 to Apr 9, 1928)
- Putah Creek near Winters (Feb 17 to Mar 13, 1940)
- Napa River near St Helena (Jan 27 to Feb 21, 1942)
- Conn Creek near St Helena (Feb 17 to Mar. 13, 1940)
- Sacramento Valley (Feb 20 to Mar. 16, 1940) including
  - Yolo By-pass near Woodland
  - Sacramento River at Sacramento
  - Sacramento Weir

STATE OF CALIFORNIA		
SAN FRANCISCO BAY DEVELOPMENT		
DESIGN FLOOD HYDROGRAPH		
INTERNATIONAL ENGINEERING CO., INC. SAN FRANCISCO, CALIF.		
DR. G.J.B. CK.	RECOMMENDED A.E. Nisbet	APPROVED D.B. Steinman
DATE: JANUARY 1951		



Years of Record 1904 to 1942 Inclusive

STATE OF CALIFORNIA		
SAN FRANCISCO BAY DEVELOPMENT FLOOD FREQUENCY		
INTERNATIONAL ENGINEERING CO., INC. SAN FRANCISCO, CALIF.		
DR. GJB CK. [illegible]	RECOMMENDED A E Rudebusch	APPROVED D J Bleifuss
DATE: JANUARY 1951		